Exercise1:(properties of vertices, symmetry and antisymmetry)

The table below shows the internal connections provided by Air-Algeria companies.

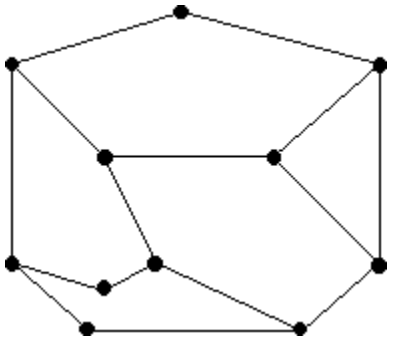
	Constantine	Annaba	Oran	Algiers	Tindouf	Ouargla
Constantine			+	+	+	+
Annaba			+	+		
Oran	+	+		+	+	+
Algiers	+	+	+		+	+
Tindouf	+					
Ouargla	+		+	+		

1- Represent the different connections by a graph.
2- Determine the destinations off lights departing from Oran.
3- List the predecessors, successors, neighbors, and degrees of each vertex.
4- Study the properties of this graph in terms of (symmetry, antisymmetry).
5- Propose a solution to make the graph antisymmetric.

Exercise2: (incidence and adjacency of vertices and edges)

The opposite graphic shows the corridors of a museum.

A guard placed in a corridor can monitor two junctions placed at its ends.
1. How many guards are needed (and how to place them) to ensure that all intersections are monitored?
2. If we now place guards at intersections, assuming one guard can monitor all corridors leading to this intersection, how many guards are needed?



Exercise3: (modeling problems by graph)

We define a relation R on the set of the first 9 non-zero natural as follows: xRy $\Longrightarrow$x is a divisor of y

1. Represent this relationship with a directed graph.
2. Determine the set of prime numbers from the graph.

Exercise4: (modeling problems by graph, complete graph)

Every day, a group of 6 children go for a walk, in sub-group of two children. How many days can they go for a walk if we want a child to never have the same neighbor twice? The same question in the case if the walk is done in sub-group of three?

Exercise5: (modeling problems by graph, complete graph)

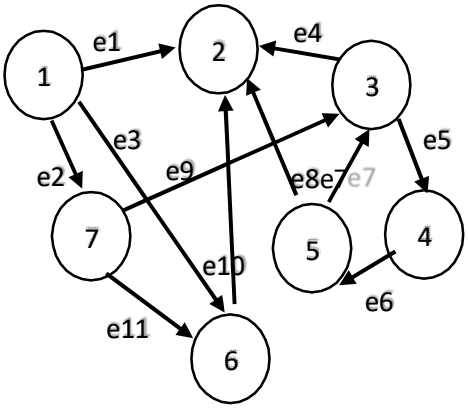
A chess tournament is played between 6 people. Each player must face all the others.

1. Construct a graph representing all possible parts.
2. What is the type of graph obtained?
3. If each player plays only one match per day, how many days will it take to complete the tournament? Use the graph to propose a schedule of matches.

Exercise6: (matrix representation of graphs, simple and elementary traversal (chain, path))

Consider the graph G:

1. Represent this graph as an adjacency matrix, then as an incidence matrix at the edges.
2. Find the longest simple path in G, indicate its cardinality.
3. Find the longest simple chain of G, indicate its cardinality.
4. Test the existence of circuits and cycles in this graph G.
5. Find all the non-elementary cycles in this graph G.



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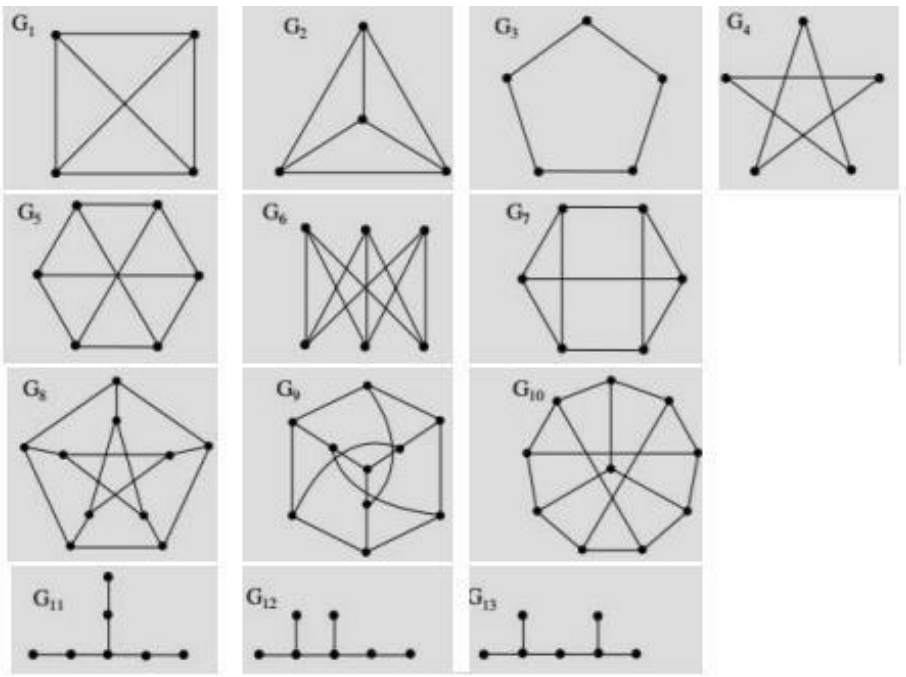
Exercise7: (graph types)

Indicate the type of each of the following graphs:



Exercise8: (bipartite graph)

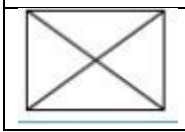
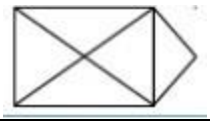
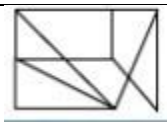
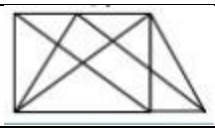
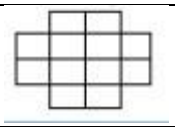
Three teachers P1, P2 and P3 will have to give a certain number of hours of lessons to three classes C1, C2 and C3 on the same day, such as:

- P1 must give 2 hours of lessons to C1 and 1 hour to C2;
- P2 must give1 hour of lessons to C1, 1 hour to C2 and 1 hour to C3;
- P3 must give1 hour of lessons to C1, 1 hour to C2 and 2 hours to 3.

Questions:
1. How can were present this situation with a graph?
2. What is the type of the obtained graph?
3. How many times lots will be required at a minimum?
4. Use the graph to suggest a schedule for these teachers (use edge coloring).

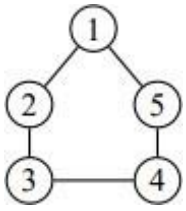
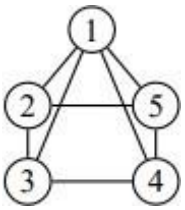
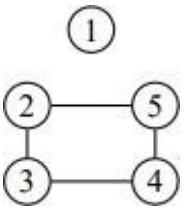
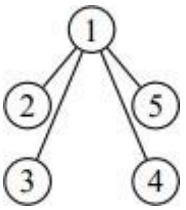
Exercise9: (Eulerian graph)

Is it possible to draw the following figures without lifting the pencil and without going over the same line twice?

G1	G2	G3	G4	G5
				

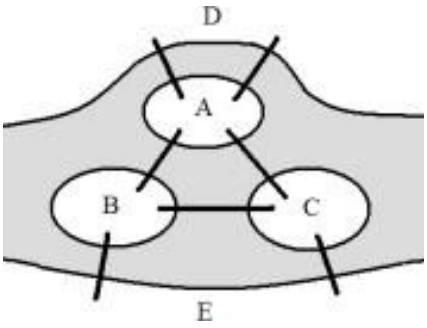
Exercise10: (Eulerian and Hamiltonian Graph)

Study the properties of the graphs below in terms of (Eulerian, Hamiltonian).

G1	G2	G3	G4
			

Exercise11: (Eulerian path/cycle)

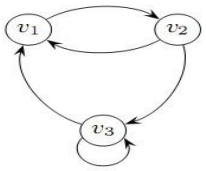
There are three islands A, B, C on a river whose banks are marked D and E, with 7 connecting bridges as in the opposite drawing. Construct the graph corresponding to this diagram, and show that it has Eulerian paths but no Eulerian cycles. Give an example of an Eulerian path.



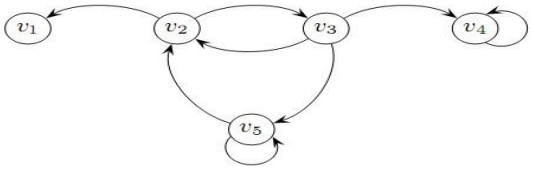
Exercise12: (strong connectivity)

Determine the strongly connected components of the following directed graphs using a labeling algorithm:

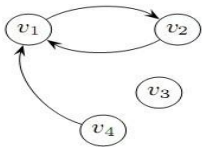
a)



b)



c)



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